Potential for a Biofuels Industry in Washington State

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A robust biofuels industry would be beneficial for Washington State

- Meet greenhouse gas emission goals. Most carbon dioxide emissions in Washington State come from transportation sector. Meeting long term carbon emission goals will require substantial renewable fuel production or importation.
- Produce high value products. Converting biomass into fuels, or chemicals, creates far more value than burning the biomass to produce power. This value will create jobs, increase the tax base, and will develop the infrastructure.
    - The economic benefits of biofuels would be greatest in rural communities since the biorefineries need to be relatively close to the raw material source, which is generally in rural areas.
- Improve forest health. Many Washington forests are in poor shape and at risk for catastrophic forest fires. In 2006, the carbon emissions from forest fires was equal to about 1 million cars and far exceeded the carbon emissions from all power production in the state. These at risk forests need to be cleaned up and that biomass would be an excellent raw material for the production of biofuels
- Value from waste materials such as municipal solid waste. Garbage, forest residuals, and agriculture residuals all make excellent feedstocks for biorefineries. Use of these materials would solve a disposal problems and would help reduce greenhouse gas emissions

What is needed for a viable biofuels industry

- Technology to convert mixed biomass to fuels. Washington is blessed with abundant biomass but it is heterogeneous. The major source of biomass is forest based which is the most recalcitrant for conversion to biofuels. The optimal biorefinery would be able to run off of all sources of biomass to minimize supply risks and use the lowest cost raw material.
    - Biomass can be converted to fuels with three basic approaches.
        - It can be heated with oxygen to produce synthesis gas (syngas), which is carbon monoxide and hydrogen. Syngas can then be run over catalyst to produce a wide range of fuels and chemicals including ethanol and petroleum like blends.
        - It can be heated in the absence of oxygen, pyrolyzed, to make biooil. Biooil is a complex mixture that has limited use as a fuel, but can be refined to make good liquid fuel. Biooil represents a way to concentrate biomass to make it easier to ship than the bulk biomass.
        - Finally one can hydrolyze the cellulose and hemicellulose to sugars then either ferment to ethanol or catalytically covert to hydrocarbons.

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    - All of these approaches can work with Washington biomass but they need to be designed for mixed feedstocks.
    - Research at University of Washington is focused on using bioconversion (sugar route) for mixed feedstocks – especially those with forest residuals. A recent Federal appropriation to the University of Washington will allow us to purchase a steam gun needed to carry out this research.
    - LCA. Regardless of the technologies selected it is essential that detailed, in-depth Life Cycle Assessments be done on those technologies. The broad impacts of the proposed technologies need to be well understood and the potential for negative outcomes articulated before commercial facilities are constructed.
- Reliable feedstock supply. Biorefineries will be big, expensive, and use a lot biomass. A typical biorefinery might produce 100 million gallons/ year of fuel or more. It would cost on the order of $500 million and use about 3500 tons of biomass a day. No will invest $500 million unless they are sure of their biomass supply!!! Generally you have to prove the supply is 2X – 5X greater than the design specification to get banks etc. to invest.
    - Current policies such as I-937 and the proposed carbon cap and trade policy encourage use of biomass for power production perhaps at the expense of use as a biofuel feedstock
- Economic value for low carbon emissions. A significant benefit of biofuels will be their low net carbon emissions. This benefit needs to be rewarded financially if biofuels are to be viable. Cap and trade mechanisms seem to be favored but they are very complex and can result in price volatility.
- Expensive oil. Various experts cite the need for oil to remain above ~ $80 barrel for biofuels to viable

Pulp and paper mills can play a big role in developing biofuels industry

- Washington pulp and paper mills could be a source new renewable power without consumption of additional biomass
    - Partial results from a survey show that the average of biomass boilers is 38 years and only four boilers are under 30 years old; generally considered the life of a boiler.
    - Survey results show that the average age of recovery boilers is 35 with 2 boilers under the age of 30
    - Replacement of these aged boilers with new high pressure, high efficiency boilers would substantially increase their power production without additional consumption of biomass.
        - The improved power production (and cost – it will be expensive) will be part of the analysis - but new pulp mills produce up to 100 MW of power of which they consume about 70 MW leaving 30 MW for export
- A pulp and paper mill is an ideal site for a biofuels biorefinery
    - Share steam and power

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    - Mill is on the grid
    - Infrastructure and know-how to handle large volumes of biomass
    - Waste treatment facilities
    - Operating permits

- Examples of UW research on biofuels
    - Barriers to using forest based biomass for fuels and power
    - Potential of Washington State pulp and paper mills to produce renewable power
    - Conversion of municipal solid waste to ethanol
    - Production of biofuels from mixed biomass feedstocks
    - Co-production of high value chemicals (glycols and sugar alcohols) with biofuels
    - Development of new fermentation organisms
    - LCA of forest-based biofuels
    - Growth of oil producing algae in waste treatment ponds
    - Instrument and controls for biorefineries
    - Novel membrane for low energy separations in biorefineries
    - Rapid growing biorefinery feedstocks - with WSU
    - Super critical biomass gasification